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The lithurgine bees of Australia (Hymenoptera: Megachilidae), with a note on *Megachile rotundipennis*

Victor H. Gonzalez^{1,2}, Michael S. Engel^{2,3}, & Terry L. Griswold⁴

Abstract. *Austrothurgus* Gonzalez & Engel, new genus, is described and figured for three species of lithurgine bees (Megachilidae: Lithurginae: Lithurgini) from Australia. *Austrothurgus* is distinguished from other Lithurginae by the presence of arolia in males (absent in females), first flagellomere long in both sexes, female facial prominence mostly involving the base of clypeus, and male metabasitarsus with distinct, elevated carina on its inner surface. *Austrothurgus malgaru* Gonzalez, Engel, & Griswold, new species, from Western Australia is also described and figured. A neotype is designated for *Lithurgus dentipes* Smith and lectotypes for *L. atratus* Smith, *L. cognatus* Smith, and *L. rubricatus* Smith. The following two new combinations are established: *A. cognatus* (Smith) and *A. rubricatus* (Smith). An updated key to the genera of Lithurgini as well as diagnoses, illustrations, and a key to the species occurring in Australia are provided. Taxonomic notes and a new lectotype designation for the Indo-Pacific species *Megachile (Eutricharaea) rotundipennis* Kirby are also appended.

INTRODUCTION

The subfamily Lithurginae Newman is a monophyletic group of megachilid bees consisting of about 60 species worldwide (Roig-Alsina & Michener, 1993; Engel, 2001; Michener, 2007; Gonzalez *et al.*, 2012). Lithurginae comprises two tribes, †Protolithurgini Engel, an extinct lineage preserved in mid-Eocene Baltic amber (Engel, 2001), and Lithurgini Newman, containing three genera *sensu* Michener (2007): *Lithurgus* Berthold, *Microthurge* Michener, and *Trichothurgus* Moure. Lithurgini occur on all continents except Antarctica, with a large number of species grouped in *Lithurgus*. Within that genus, two subgenera have been recognized, *Lithurgus* s. str. and *Lithurgopsis* Fox. The first subgenus contains most of the species and is restricted to the Eastern Hemi-

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sphere, except for *Lithurgus huberi* Ducke, a species that may be adventive to South America (Snelling, 1983; Roig-Alsina, 2006; Gonzalez *et al.*, 2013); the other subgenus contains only nine species, is restricted to the Western Hemisphere, and is treated at the generic level in the classification of Moure & Melo (2007).

The monophyly of the genera of Lithurginae *sensu* Michener (2007) is not questioned, except for that of *Lithurgus*. Unlike all other species of *Lithurgus* s. str., the male of the Australian species *L. rubricatus* Smith possesses distinct, large arolia on all legs, similar to those of the male of *Lithurgopsis*; however, that species does not agree with *Lithurgopsis* in other characters, namely the length and width of the first and second flagellomeres and the areas of the face modified into a prominence in the female. Also, in an exploratory phylogenetic analysis of the Lithurginae, *L. rubricatus* did not cluster with either *Lithurgus* s. str. or *Lithurgopsis* (Engel, 2001), thus casting doubts on its phylogenetic position. As of today, *L. rubricatus* is the only known species of *Lithurgus* s. str. with arolia in the male and its taxonomic placement remains uncertain.

Herein we document two additional Australian species with arolia in the male, one of them new to Science, and propose a new generic name for them, *Austrothurgus* Gonzalez & Engel. We also follow Moure & Melo (2007) in recognizing *Lithurgopsis* at the generic level (Table 1). We provide an updated key to the genera of Lithurgini as well as taxonomic comments, diagnoses, illustrations, and a key to the species occurring in Australia. Taxonomic notes and a new lectotype designation for the Indo-Pacific species *Megachile* (*Eutricharaea*) *rotundipennis* Kirby are also appended (Appendix, *vide infra*).

MATERIAL AND METHODS

Morphological terminology follows that of Engel (2001) and Michener (2007), except for torulus is herein used instead of antennal alveolus. Forewing length was measured from the apex of the humeral sclerite to the apex of the wing margin; ratios were rounded to the nearest tenth. Photomicrographs were prepared using a Canon 7D digital camera attached to an Infinity K-2 long-distance microscope lens, and were assembled with the CombineZM™ software package. Measurements were made with

Table 1. Hierarchical classification of Lithurginae *sensu* Gonzalez *et al.* (2012), including number of species and general distribution. † = extinct taxa; * = introduced.

Taxon	No. of Species	Distribution
Tribe Lithurgini Newman, 1834		
Genus <i>Austrothurgus</i> Gonzalez & Engel, n. gen.	3	Australia
Genus <i>Lithurgopsis</i> Fox, 1902	9	USA to Argentina
Genus <i>Lithurgus</i> Berthold, 1827	33	Eurasia, Africa, Australia, *South America
Genus <i>Microthurge</i> Michener, 1983	4	Argentina, Bolivia, Brazil
Genus <i>Trichothurgus</i> Moure, 1949	14	Argentina, Chile, Peru
Tribe †Protolithurgini Engel, 2001		
Genus † <i>Protolithurgus</i> Engel, 2001	1	Baltic amber

an ocular micrometer attached to an Olympus SZX-12 stereomicroscope. Institutional initials used herein for repositories holding material are: NHML, Department of Entomology, The Natural History Museum, London, United Kingdom and WAM, Western Australian Museum Insect Collection, Perth, Australia.

SYSTEMATICS

Subfamily Lithurginae Newman

Tribe Lithurgini Newman

Austrothurgus Gonzalez & Engel, new genus

ZooBank urn:lsid:zoobank.org:act:466F096E-7492-4B12-BD0B-4DD1A6E9D220

TYPE SPECIES: *Lithurgus rubricatus* Smith, 1853.

DIAGNOSIS: This genus can be readily distinguished from all other lithurgine genera by the following combination of characters: arolia present in males, absent in females; first flagellomere long in both sexes, at least 1.5 times longer than broad, about twice as long as second, which is much broader than long; female facial prominence mostly involving base of clypeus; and male metabasitarsus with distinct, strong carina on inner surface (Figs. 5, 10, 15).

DESCRIPTION: Robust, middle-sized species (10–15 mm in body length) with apical fascia on metasomal terga; epistomal sulcus present between tentorial pits in both sexes; labrum about as long as clypeus, with strong transverse ridge at base; facial prominence involving base of clypeus, poorly developed in male; maxillary and labial palpi tetramerous (four-segmented); first flagellomere long, at least 1.5 times longer than broad, about twice as long as second, which is much broader than long; pretarsal claws simple in female, cleft in male; aroliae absent in female, present in male; female tibiae tuberculate on outer surfaces, in male tubercles reduced on mesotibia and absent on metatibia; metabasitarsus slightly shorter than metatibia in female, slightly longer than half metatibial length in male; metatibial spurs slender, not or scarcely bent apically.

ETYMOLOGY: The new genus-group name makes reference to the Australian distribution of this taxon. The name is masculine.

COMMENTS: *Austrothurgus* is most similar to *Lithurgus* in the proportions of the first and second flagellomeres in both sexes, but it can be distinguished by the presence of the arolia in the male, the female facial prominence mostly involving the base of the clypeus, and the male metabasitarsus with an inner asetose area projecting into a distinct carina. In *Lithurgus* the arolia are absent or rudimentary in both sexes, the female facial prominence involves the base of the clypeus and part of the supraclypeal area, and the inner asetose area of the male metabasitarsus is usually absent, and when present (e.g., *L. atratus* Smith, *L. huberi*), it does not project into a distinct carina.

INCLUDED SPECIES: In addition to the type species, *A. rubricatus*, the genus includes *A. cognatus* (Smith, 1868) and *A. malgaru* Gonzalez, Engel, & Griswold, new species (*vide infra*).

Austrothurgus rubricatus (Smith), **new combination**
(Figs. 1–5)

Lithurgus rubricatus Smith, 1853: 146. Lectotype (**new designation**): NHML No. 17.a.2096; ♀, Cape Upstart, Queensland, Australia.



Figures 1–5. Photomicrographs of lectotype female (1–4) and male (5) of *Austrothurgus rubricatus* (Smith). 1. Lateral habitus. 2. Dorsal habitus. 3. Lateral view of head. 4. Facial view. 5. Male metatarsus, depicting modification of metabasitarsus.

DIAGNOSIS: Both sexes of this species are most similar to those of *A. cognatus* from which they can be distinguished easily by the characters indicated in the key and comparative comments of the diagnosis of that species (*vide infra*).

COMMENTS: This species was described based on both sexes. To stabilize the name the female is designated as lectotype. The label data for this specimen are as follow:

Type // BM. TYPE HYM. 17.a.2096// *rubricatus* Type Sm [handwritten] // *Lithurgus rubricatus* Type Smith // 4b 43 [round label] // Lectotype, *Lithurgus rubricatus* Smith des. V.H. Gonzalez, M.S. Engel & T. Griswold ♀.

Austrothurgus cognatus (Smith), **new combination**
(Figs. 6–10)

Lithurgus cognatus Smith, 1868: 255. Lectotype (**new designation**): NHML No. 17.a.2099; ♀, Champion Bay (Geraldton), Western Australia, Australia.

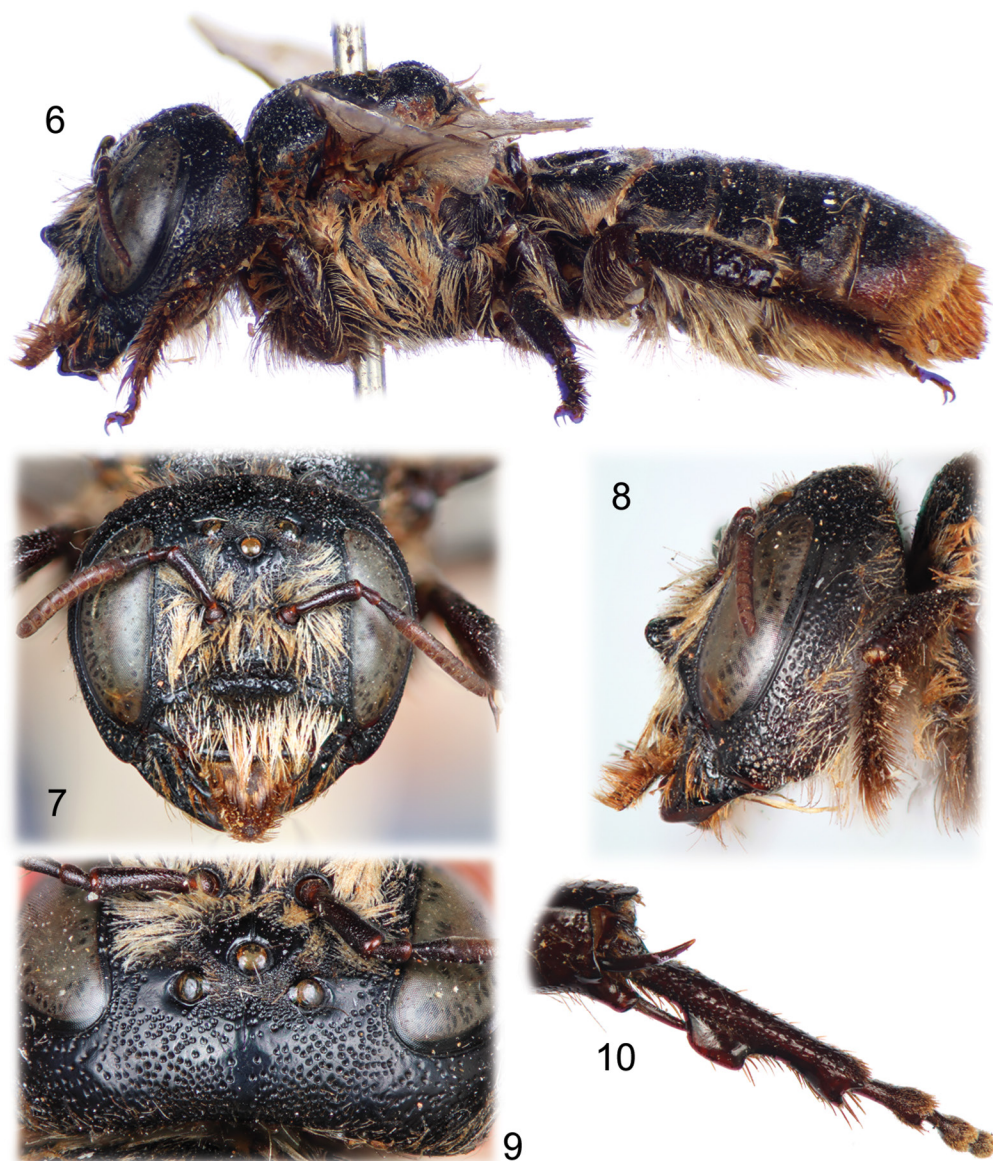
DIAGNOSIS: The female of this species is similar to that of *A. rubricatus* in the sternal scopa and fifth and sixth terga with distal margins entirely covered with yellowish to light reddish brown setae (Fig. 6). It can be distinguished from that species by the following combination of characters: large bees (head width 4.8–5.1 mm, body length 16–17 mm); clypeus smooth, shiny, distinctly swollen laterally along epistomal sulcus (Figs. 6–8); vertex with large impunctate areas (Fig. 9); facial prominence with deep median emargination, appearing bilobed in dorsal view, projecting about 0.7 times width of compound eye in profile (Figs. 6–8); and mesoscutum and mesoscutellum smooth and shiny, with distinct transverse, irregular rugulae. The male also resembles that of *A. rubricatus* in the distal terga with light reddish brown setae on their discs contrasting with the remaining terga covered by dark brown to black setae. However, in *A. cognatus* the metabasitarsal carina is long, about as long as the distance from its superior margin to the base of the metabasitarsus (Fig. 10), whereas in *A. rubricatus* the metabasitarsal carina is much shorter than the distance between its superior margin and the base of the metabasitarsus (Fig. 5).

COMMENTS: This species was described based on both sexes. The female is more distinctive than the male and herein is designated as lectotype to stabilize the name. The label data for this specimen are as follow: Type // BM. TYPE HYM. 17.a.2099// *Lithurgus cognatus* Smith [handwritten, blue label] // W. Australia // Lectotype, *Lithurgus cognatus* Smith des. V.H. Gonzalez, M.S. Engel & T. Griswold ♀.

Austrothurgus malgaru Gonzalez, Engel, & Griswold, new species
ZooBank urn:lsid:zoobank.org:act:2F73CCBD-E6D3-4DB7-99EB-52BA9253EABA
(Figs. 11–16)

DIAGNOSIS: This species is known only from the male. It can be distinguished easily from *A. cognatus* and *A. rubricatus* by the metasomal terga with black to dark brown setae on their discs (Figs. 11, 12, 16) and the inner surface of the metabasitarsus with a low projection near the apex (Fig. 15). In both *A. cognatus* and *A. rubricatus* the distal terga have light reddish brown setae on their discs and the metabasitarsi have a strong, high carina projecting near basitarsal midlength (Figs. 5, 10).

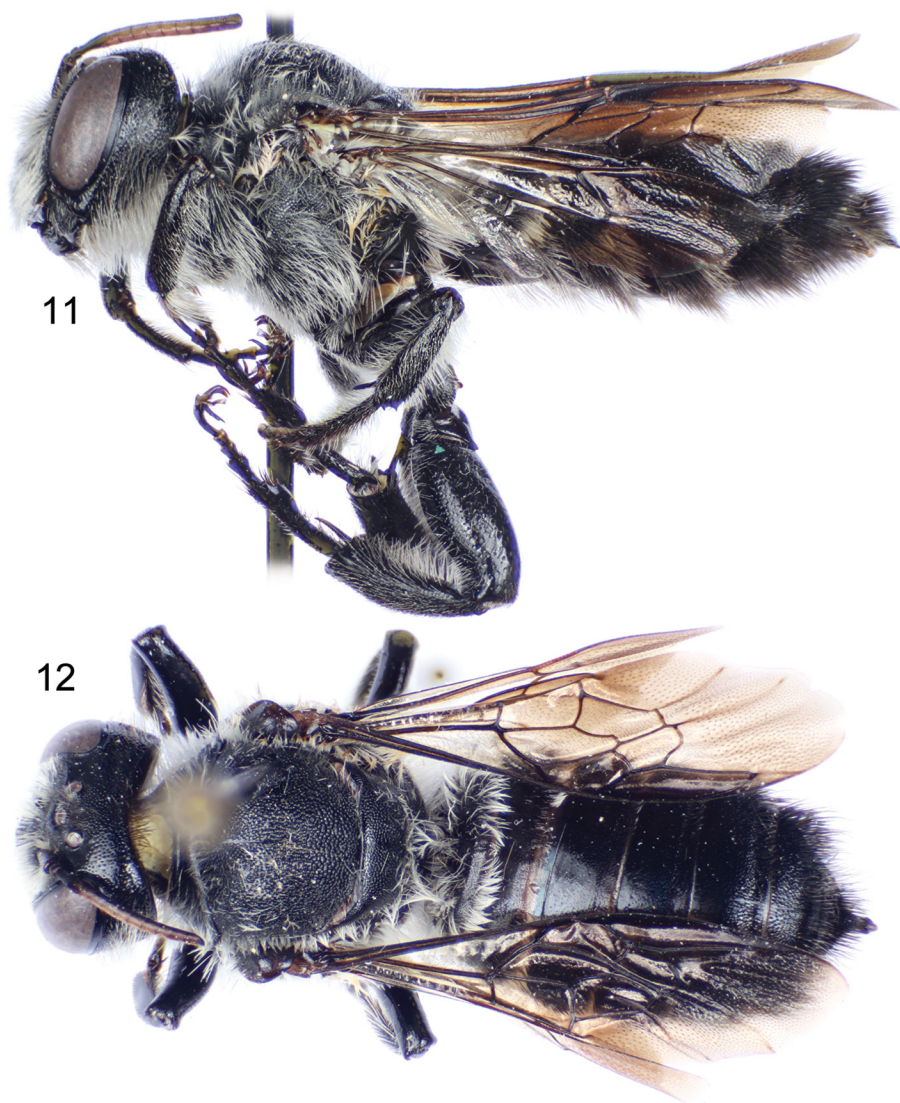
DESCRIPTION: ♂: Body length 14.4 mm; forewing length 8.7 mm. Head 1.3 times broader than long; inner orbits of compound eyes slightly diverging ventrally (Fig. 13); intertorular distance 1.8 times torular diameter, 1.2 times torulorbital distance; interocellar distance 2.4 times median ocellar diameter, 1.4 times ocellocular distance; ocelloccipital distance 2.8 times median ocellar diameter; vertex rounded in frontal view; preoccipital border rounded, weakly concave in dorsal view; compound eye 2.5 times longer than wide; gena about as wide as compound eye in profile, widest medially; clypeus about twice as broad as long, distinctly protuberant on basal half; scape



Figures 6–10. Photomicrographs of lectotype female (6–9) and male (10) of *Austrothurgus cognatus* (Smith). 6. Lateral habitus. 7. Facial view. 8. Lateral view of head. 9. Detail of vertex. 10. Male metatarsus (apex missing), depicting modification of metabasitarsus.

about 3.2 times longer than broad, reaching upper margin of median ocellus in repose, pedicel about as long as broad, first flagellomere 1.7 times longer than broad, about twice as long as pedicel, 1.8 times longer than second flagellomere, second flagellomere broader than long, remaining flagellomeres progressively increasing in length towards apex. Metabasitarsus with anterodistal margin projecting into spine, with inner glabrous surface projecting as low carina near apex (Fig. 15). Pygidial plate as in figure 16.

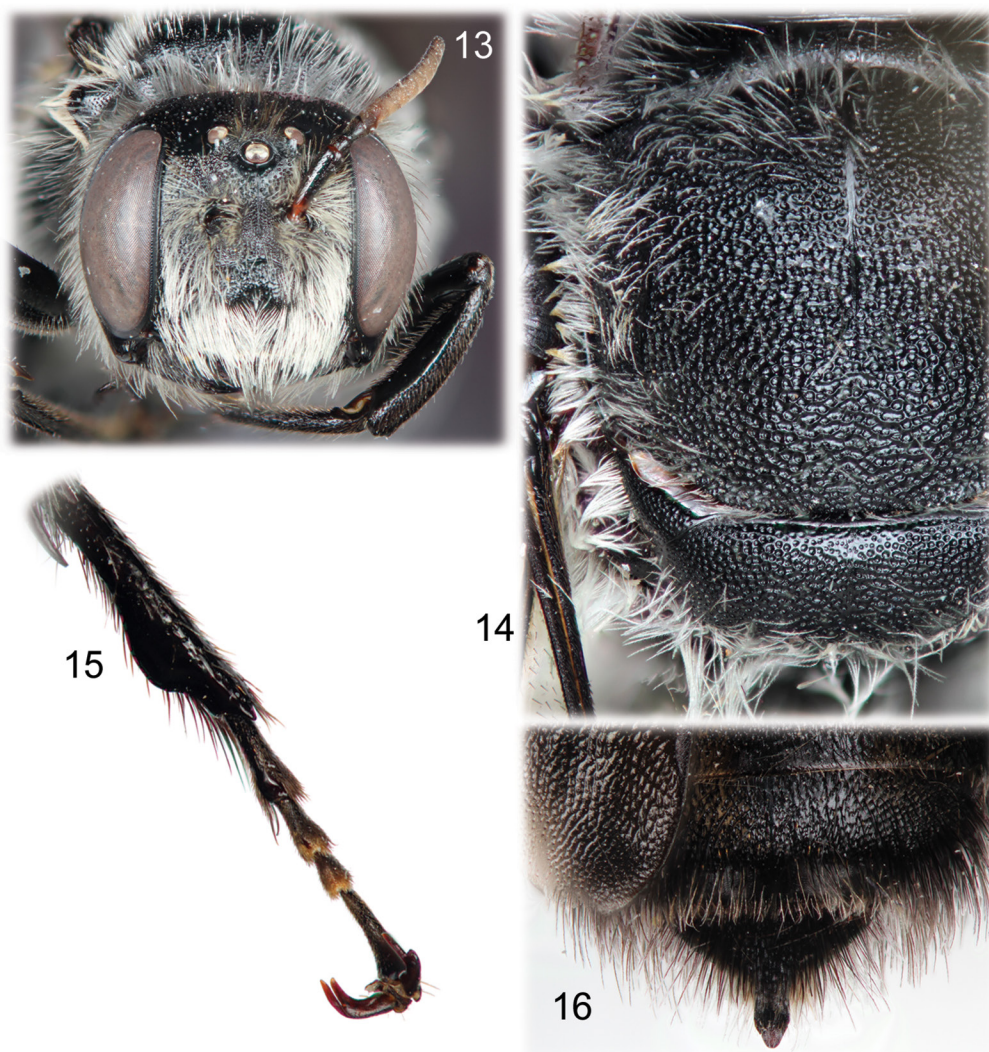
Body color black throughout, except dark reddish brown on pretarsal claws of all legs and antenna (except yellowish on dorsal surface of third to eleventh flagel-



Figures 11–12. Photomicrographs of holotype male of *Austrothurgus malgaru*, new species. 11. Lateral habitus. 12. Dorsal habitus.

lomeres). Wing membrane dark brown, except bases of hind wings translucent; veins dark brown including prestigma and pterostigma.

Integument generally smooth and shiny between punctures, except strongly imbricate on propodeum and weakly imbricate on tegula, pro- and metafemora, metatibia, and metasomal sterna and terga. Clypeus with minute, contiguous punctures on distal half, punctures becoming larger towards base; inferior paraocular and supraclypeal areas minutely punctate as on distal half of clypeus, punctures slightly larger; superior paraocular and subocellar areas largely impunctate, smooth and shiny; interocellar area with minute, contiguous punctures, dull; vertex with larger punctures than on face, about one-sixth median ocellar diameter, punctures separated by at most a puncture width; gena with punctures slightly shallower and sparser than on vertex,



Figures 13–16. Photomicrographs of holotype male of *Austrothurgus malgaru*, new species.

13. Facial view. 14. Detail of sculpturing on mesoscutum and mesoscutellum. 15. Metatarsus, depicting modification of metabasitarsus. 16. Apex of metasoma.

punctures coarser, contiguous on postgena. Mesosoma with punctures strong, contiguous, larger than those on vertex, except as follows: mesoscutum with punctures on posterior third of disc forming weak rugulae (Fig. 14); punctures absent from most of metepisternum; sides and posterior surface of propodeum with punctures small, separated by at least a puncture width; tegula with minute punctures separated by at least two puncture widths. Metasomal terga finely punctate, punctures smaller, sparser than on vertex, punctures becoming larger and denser towards apical terga; sterna with punctures coarser, sparser than on terga.

Pubescence in general long, dense, white, minutely branched, except: vertex, metabasitarsus, and discs of metasomal terga and second to sixth sterna with dark brown setae; apical margins of first, second, and sixth metasomal terga, apicolateral margins

of third to fifth terga, and distal margins of second to fifth sterna with white fasciae; setae short (about as long as median ocellar diameter) and sparse on discs of mesoscutum and mesoscutellum; those on clypeus apically directed, obscuring integument except basally; setae longer (three to four times median ocellar diameter) on gena, ventral margin of mandible, sides of propodeum, and first tergum; discs of metasomal terga with short (about as long as median ocellar diameter), sparse, semi-erect, simple dark brown setae, setae increasing in length and density towards apical terga; metabasitarsus and second metatarsomere with distinct, glabrous inner surfaces.

♀: Unknown.

HOLOTYPE: ♂, Australia: Western Australia, Kennedy Range NP [National Park], Temple Gorge, 24°39.7'S, 115°10.4'E, 300m, 26 April-3 May03 [2003], F.D. Parker, M.E. Irwin (WAM).

ETYMOLOGY: The specific epithet honors the Malgaru, an aboriginal Australian tribe that formerly occupied the Kenney Range National Park, the type locality of the species.

Genus *Lithurgus* Berthold

Lithurge Latreille, 1825: 463 [French vernacular name]. Type species: *Andrena cornuta* Fabricius, 1787, monobasic.

Lithurgus Berthold, 1827: 467, *nomen emendatum pro Lithurge* Latreille, 1825. Type species: *Andrena cornuta* Fabricius, 1787, autobasic [Michener (1997) listed this as a subsequent designation].

Liturgus Ashmead, 1899: 77, *lapsus calami pro Lithurgus* Berthold, 1827.

COMMENTS: We have removed *Lithurgopsis* from *Lithurgus*, thereby not recognizing subgenera within this genus (as was done by Moure & Melo, 2007), and consider the two to be generically distinct (refer also to the key to genera: *vide infra*). This action accords with past and current studies indicating that the former composition of *Lithurgus* in a broader sense was paraphyletic (Engel, 2001; Michener, 2007). As it is, the restriction of *Lithurgus* as such may not resolve all issues pertaining to its paraphyly. However, we believe that this is a necessary first step toward eventually achieving a stable and useful classification of Lithurgini.

Lithurgus andrewsi Cockerell (Figs. 17–19)

Lithurgus andrewsi Cockerell, 1909: 312. Holotype: NHML No. 17.a.2068a; ♀, near Flying-Fish Cove, Christmas Island, Australia.

DIAGNOSIS: The female of this species can be distinguished easily from other Australian species of *Lithurgus* by the following combination of characters: distal terga with reddish setae as on sternal scopa (Fig. 17); mesoscutum rugulose; mesoscutellum mostly coarsely, densely foveate; facial prominence broadly convex, wide, about 0.6 times length of lower interorbital distance (Fig. 18); and vertex with contiguous punctures (Fig. 19).

COMMENTS: This species is only known from Christmas Island, the type locality. As stated by Cockerell (1909), this species was described based on a female, the only female specimen among those studied by W.F. Kirby (1900) in his description of *Mega-*



Figures 17–19. Photomicrographs of holotype female of *Lithurgus andrewsi* Cockerell. 17. Lateral habitus. 18. Facial view. 19. Detail of vertex.

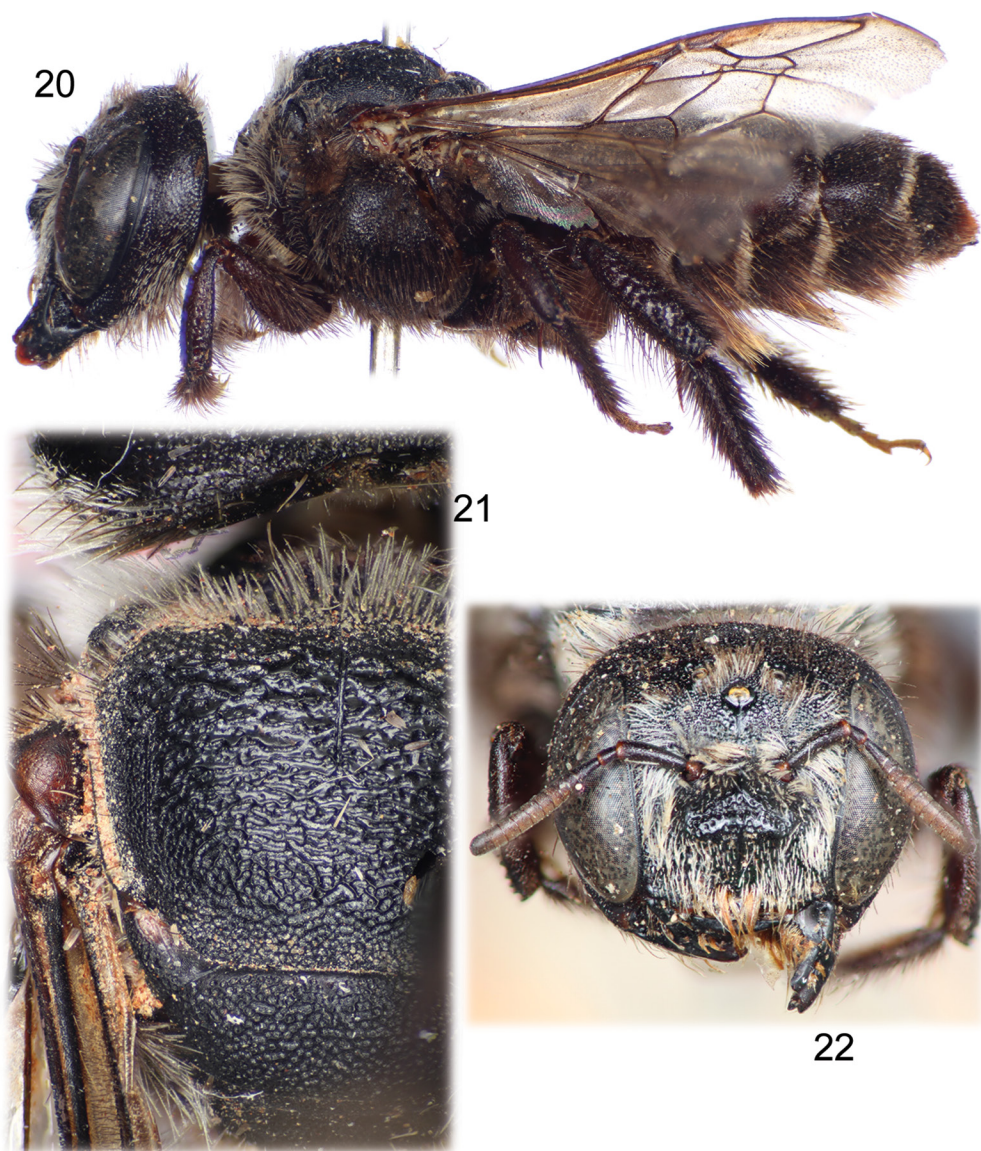
chile rotundipennis from Christmas Island (Appendix, *vide infra*). Thus, there is no need to designate it as lectotype.

Lithurgus atratiformis Cockerell
(Figs. 20–22)

Lithurgus atratiformis Cockerell, 1905: 295. Holotype: NHML No. 17.a.2098; ♀, NW coast of Australia.

DIAGNOSIS: Among Australian *Lithurgus*, *L. atratiformis* is most similar to *L. atratus* Smith in the black or dark brown sternal scopa, distal terga with dark setae (Fig. 20), and mesoscutum with strong rugulae (Fig. 21). The female can be distinguished from that species primarily by its larger body size (head width 4.5 mm vs. 4.2 mm) and broader facial prominence (Fig. 22, about two-thirds length of lower interorbital distance vs. about half length of lower interorbital distance).

COMMENTS: Cockerell (1905) did not state the number of specimens on which he based the description of *L. atratiformis* but the female specimen deposited in the NHML



Figures 20–22. Photomicrographs of holotype female of *Lithurgus atratiformis* Cockerell.
20. Lateral habitus. 21. Detail of sculpturing on mesoscutum and mesoscutellum. 22. Facial view.

has a label in Cockerell's handwriting that reads "type". Cockerell usually labeled one specimen as "type" and the others in the type series as "cotypes", corresponding to the modern holotype and paratype concepts. A designation of lectotype is therefore not necessary as the NHML specimen is assuredly a holotype.

As indicated by Michener (1965), *L. atratiformis* is morphologically very similar to *L. atratus*, *L. scabrosus* (Smith), and *L. collaris* Smith and they may be conspecific. Except for subtle differences in body size, we did not find consistent morphological differences between the male specimens associated with females that matched the type



Figures 23–24. Photomicrographs of lectotype female of *Lithurgus atratus* Smith. 23. Lateral habitus. 24. Facial view.

of *L. atratiformis* and those males associated with females that matched the type of *L. atratus*. For this reason, the males of both species are not separated in the key.

Lithurgus atratus Smith
(Figs. 23–24)

Lithurgus atratus Smith, 1853: 145. Lectotype (**new designation**): NHML No. 17.a.2094; ♀, India. *Lithurgus dentipes* Smith, 1853: 146. Neotype (**new designation**): NHML; ♂, [Australia?]; synonymy by inference from Lieftinck (1939).

DIAGNOSIS: This species is most similar to *L. atratiformis* from which it can be distinguished primarily by the smaller body size (*vide supra*).

COMMENTS: *Lithurgus atratus* was described from four females and no holotype was designated. To stabilize the name, one of these females is here designated as lectotype. The label data for this specimen are as follow: Type // BM. TYPE HYM. 17.a.2094 // atratus Type Sm [handwritten] // *Lithurgus atratus* Type Smith [handwritten] // Lectotype, *Lithurgus atratus* Smith des. V.H. Gonzalez, M.S. Engel & T. Griswold ♀.

Lithurgus dentipes was likely described from a single male from “New Holland” (Australia), as there is no mention of any other specimens in Smith’s (1853) original



Figure 25. Photomicrographs of labels and neotype male of *Lithurgus dentipes* Smith (= *L. atratus* Smith).

description. Thus, such a male should be considered the holotype. Cockerell (1930: 207) indicated that he examined the holotype of this species at the NHML and commented on its resemblance with *L. atratus*. However, without further explanation, Michener (1965: 185) pointed out that the specimen at NHML, probably the same one examined by Cockerell, was not the true type of *L. dentipes*. In Smith's 1853 publication, the marginal annotation "BM" (today NHML), next to the species description, has been interpreted by some authors as indication that the actual type was found there, but it appears that what Smith really meant was that the species merely was represented in the museum's collection (Baker, 1993: 11). Also, while quoting Michener's statement in her catalogue of the bees from Australia, Cardale (1993: 240) indicated that in 1988 this specimen could not be located at NHML. Baker (1993), who studied in detail the type material of Smith, did not comment on the identity of the type of *L. dentipes*. Thus, as of today, the whereabouts of the type of *L. dentipes* are unknown and a taxonomic action is required to stabilize this name. Herein, we designate as neotype a male specimen from Smith's collection that matches the original description of *L. dentipes* (Fig. 25). This male is probably the same specimen examined by both Cockerell and Liefnick. It bears three labels (Fig. 25): one of them indicates that it was received by the NHML in 1899 as a gift of Mrs. Farren White; another says "*Lithurgus atratus*, Sm", probably added by Cockerell, as we can infer from the handwriting and the comments he made on the specimen he studied (Cockerell, 1930: 207); and a label added by Liefnick suggesting that this specimen might be the type of *L. dentipes* (Fig. 25). We do not know when or where this specimen was collected because there is no collection data associated with it; however, it is known that a significant portion of Smith's exotic material was kept in White's collection until 1899, when it was donated to the NHML (Baker, 1993: 53). Therefore, it is likely that this specimen might have been collected in Australia (or somewhere in the region) well before 1879, the year Smith passed away. Perhaps because of the issues explained above, Michener (1965) thought of the male specimen deposited at the NHML as a false type, if this specimen was the same one examined by him. Another possibility is that Michener (1965) examined a female specimen that was erroneously labeled at some point as the type of *L. dentipes* (as type Hym. 17a. 2095). We might never know which was the case, but given that the male specimen matches the original description of *L. dentipes*, it comes

from the Smith collection, and it was examined by both Cockerell and Liefnick, we have chosen it as neotype. It is impossible to say whether this is the specimen Smith based his description upon and therefore it cannot be considered a holotype, thusly necessitating the neotype designation. The label data for this specimen are as follow: Smith coll., pres. by Mrs. Farren White, 99-303 // *Lithurgus atratus* Sm [handwritten] // ? type of dentipes Sm which is a ♂ Liefnick // Neotype, *Lithurgus dentipes* Smith des. V.H. Gonzalez, M.S. Engel & T. Griswold ♂.

Key to the genera of Lithurgini
(Modified from Michener, 2007)

1. Labrum longer than clypeus, often much longer; metatibia of female rather uniformly setose on outer, anterior, and posterior surfaces, spicules relatively inconspicuous among setae; lower mandibular tooth longer than middle tooth, or, in some females, lower and middle teeth equal (South America) *Trichothurgus* Moure
- . Labrum about as long as clypeus; metatibia of female with setae of broad, longitudinal outer zone shorter and sparser than those of anterior and posterior surfaces, spicules large and conspicuous in outer zone; lower mandibular tooth conspicuously shorter than middle tooth, which is longest mandibular tooth 2
- 2(1). Body small, slender, hoplitiform; pretarsal claws of female cleft; pterostigma of moderate size, broadest at base of vein r-rs, sides converging toward base; maxillary palpi dimerous (two-segmented) (South America) *Microthurgus* Michener
- . Body broad, megachiliform; pretarsal claws of female simple; pterostigma small, sides basal to vein r-rs parallel or nearly so [in some small species of *Lithurgus* the pterostigma is larger, approaching the size of that of *Microthurgus*]; maxillary palpi trimerous or tetramerous (three- or four-segmented) 3
- 3(2) Males 4
- . Females 6
- 4(3) Arolia absent or rudimentary *Lithurgus* Berthold
- . Arolia present 5
- 5(4) Metabasitarsus without distinct projections, carina or protuberance on inner surface, at most with small, smooth, shiny, asetose area distally; outer metatibial spur stout, strongly bent apically; first flagellomere short, not or little longer than broad, at most slightly longer than second, which is at most slightly longer than broad (Western Hemisphere) *Lithurgopsis* Fox
- . Metabasitarsus with distinct carina on asetose inner surface (Figs. 5, 10, 15); outer metatibial spur slender, straight or scarcely bent apically; first flagellomere long, more than 1.5 times longer than broad, nearly twice as long as second, which is much broader than long; Australian mainland *Austrothurgus* Gonzalez & Engel, n. gen.
- 6(3) Outer metatibial spur stout, strongly bent apically; first flagellomere short, not or little longer than broad, at most slightly longer than second, which is at most slightly longer than broad; facial prominence of female entirely supraclypeal (absent in one species); Western Hemisphere *Lithurgopsis* Fox
- . Outer metatibial spur slender, straight or scarcely bent apically; first flagellomere long, more than 1.5 times longer than broad, nearly twice as long as

- second, which is much broader than long (except in one undetermined species from India); facial prominence of female involving base of clypeus and sometimes part of supraclypeal area 7
- 7(6). Facial prominence involving base of clypeus and part of supraclypeal area (Figs. 18, 24); widespread including Australia *Lithurgus* Berthold
- . Facial prominence mostly involving base of clypeus (Figs. 4, 7); Australian mainland *Austrothurgus* Gonzalez & Engel, n. gen.

Key to the species of Lithurgini from Australia

Females

The female of *A. malgaru* is unknown and is not included in the key.

1. Sternal scopa dark reddish brown to black (Fig. 20); fifth and sixth terga with dark brown to black setae on discs, except sometimes light reddish brown setae surrounding pygidial plate 2
- . Sternal scopa yellowish to light reddish brown (Fig. 1); fifth tergum distally and sixth tergum entirely with light reddish brown setae, contrasting with remaining tergal discs covered by dark brown to black setae 3
- 2(1). Facial prominence broad, about two-thirds length of lower interorbital distance measured at same level (Fig. 20); head width ~4.5 mm *Lithurgus atratiformis* Cockerell
- . Facial prominence narrower, about half length of lower interorbital distance measured at same level (Fig. 24); head width ~4.2 mm *Lithurgus atratus* Smith
- 3(1). Vertex behind ocelli with contiguous punctures (Fig. 19); facial prominence involving base of clypeus and part of supraclypeal area, broadly convex across length, somewhat flattened anteriorly, as seen in profile (Fig. 18); Christmas Island *Lithurgus andrewsi* Cockerell
- . Vertex behind ocelli with sparser punctures, not contiguous (Fig. 9); facial prominence with abrupt projection at base of clypeus, not broadly convex across its length (Figs. 4, 7, 8); Australian mainland 4
- 4(3). Clypeus smooth, shiny, and distinctly swollen laterally along epistomal sulcus; facial prominence with deep median emargination, appearing bilobed in dorsal view, projecting about 0.7 times width of compound eye in profile (Figs. 7, 8); head width 4.8–5.1 mm *Austrothurgus cognatus* (Smith)
- . Clypeus punctate, dull, and flat laterally along epistomal sulcus; facial prominence at most with weak median emargination, not bilobed in dorsal view, projecting about half width of compound eye in profile (Figs. 3, 4); head width 4.4–4.5 mm *Austrothurgus rubricatus* (Smith)

Males

The male of *L. andrewsi* is unknown and is not included in the key.

1. Arolia absent; metabasitarsus without distinct projection or carina on inner surface, at most with smooth, shiny, asetose area on distal one-third *Lithurgus atratus* Smith / *L. atratiformis* Cockerell
- . Arolia present; metabasitarsus with distinct carina on inner surface (Figs. 5, 10, 15) 2

- 2(1). All terga with dark brown to black setae on discs (Figs. 11, 12); inner surface of metabasitarsus with low projection near apex (Fig. 15) *Austrothurgus malgaru* Gonzalez, Engel, & Griswold, n. sp.
- Distal terga with light reddish brown setae on discs contrasting with remaining terga covered by dark brown to black setae (Figs. 1, 2, 6); inner surface of metabasitarsus with high carina projecting near midlength of tarsomere (Figs. 5, 10) 3
- 3(2). Mesoscutum with coarse, contiguous punctures, without distinct transverse rugulae; inner surface of metabasitarsus with carina long, about as long as distance between its superior margin to base of metabasitarsus (Fig. 10); head width 3.9–4.1 mm *Austrothurgus cognatus* (Smith)
- Mesoscutum with distinct, transverse, irregular rugulae; inner surface of metabasitarsus with carina short, much shorter than distance between its superior margin to base of metabasitarsus (Fig. 5); head width 3.4–3.5 mm *Austrothurgus rubricatus* (Smith)

DISCUSSION

Depending on the classification followed, *Austrothurgus* could be treated either as a genus or as a subgenus of *Lithurgus*. However, adopting the second option may render *Lithurgus* paraphyletic as it is currently suspected (Engel, 2001; Michener, 2007). Independent of the classification followed, *Austrothurgus* clearly represents a lineage of lithurgine bees that is well supported by a unique combination of several morphological characters in both sexes, but particularly in the male; its recognition, along with removal of *Lithurgopsis* (*vide supra*), makes *Lithurgus* a more diagnosable and homogenous group.

Undoubtedly, a phylogenetic analysis will help to clarify the relationships of *Austrothurgus* and its correct taxonomic placement. It will also shed some light on the evolution of the arolia, a character widely believed of taxonomic importance in bee systematics. It is often assumed that character loss is more common than character recurrence, but at least in Megachilini both phenomena appear to be equally likely (Gonzalez, 2008). The lack of arolia is a usual tribal character but arolia are present in several megachiline taxa (*e.g.*, *Noteriades* Cockerell, *Heriadopsis* Cockerell, and *Matangapis* Baker & Engel: *vide* Peters, 1970; Baker & Engel, 2006; Griswold & Gonzalez, 2011; Gonzalez *et al.*, 2012).

Despite the small number of species in *Lithurgus* s. str., the status of most of them remains questionable, particularly those from Southeast Asia. For example, at least eight 'species' that are closely related to *L. atratus* have been suggested to represent a single taxonomic unit (Lieftnick, 1939; Michener, 1965), although they could be a complex of rather cryptic species. Some of these are practically indistinguishable from *L. atratus*, differing mostly in body size (*e.g.*, *L. atratiformis* Cockerell). Undoubtedly, a revision of the group that includes a great number of specimens from multiple locations (thereby necessitating extensive fieldwork as existing collections have significant gaps for *Lithurgus* across its distribution) is needed before any taxonomic action can be taken with certainty.

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REFERENCES

- Ashmead, W.H. 1899. Classification of the bees, or the superfamily Apoidea. *Transactions of the American Entomological Society* 26(1): 49–100.
- Baker, D.B. 1993. *The Type Material of the Nominal Species of Exotic Bees described by Frederick Smith*. Ph.D. dissertation, Oxford University; Oxford, UK; [i]+[i]–vi+312+14 pp.
- Baker, D.B., & M.S. Engel. 2006. A new subgenus of *Megachile* from Borneo with arolia (Hymenoptera: Megachilidae). *American Museum Novitates* 3505: 1–12.
- Berthold, A.A. 1827. *Latreille's natürliche Familien des Tierreichs. Aus dem Französischen, mit Anmerkungen und Zusätzen*. Verlage des Gr.H.S. priv. Landes-Industrie-Comptoirs; Weimar, Germany; x+606 pp.
- Cardale, J.C. 1993. Hymenoptera: Apoidea. In: Houston, W.W.K., & G.V. Maynard (Eds.), *Zoological Catalogue of Australia* [Volume 10]: 1–405. AGPS [Australian Government Publishing Service]; Canberra, Australia; ix+406 pp.
- Cockerell, T.D.A. 1905. Descriptions and records of bees.–II. *Annals and Magazine of Natural History, Series 7* 16(93): 292–301.
- Cockerell, T.D.A. 1909. Descriptions and records of bees.–XXII. *Annals and Magazine of Natural History, Series 8* 4(22): 309–317.
- Cockerell, T.D.A. 1930. The bees of Australia. *Australian Zoologist* 6: 137–156, 205–236.
- Engel, M.S. 2001. A monograph of the Baltic amber bees and evolution of the Apoidea (Hymenoptera). *Bulletin of the American Museum of Natural History* 259: 1–192.
- Fabricius, J.C. 1787. *Mantissa Insectorum, sistens eorum species nuper detectas adiectis characteribus genericis, differentiis, specificis emendationibus, observaionibus* [Tome I]. C.G. Proft; Hafniae [Copenhagen], Denmark; xx+348 pp.
- Fox, W.J. 1902. *Lithurgopsis*, a new genus of bees. *Entomological News* 13(3): 137–140.
- Gonzalez, V.H. 2008. *Phylogeny and classification of the bee tribe Megachilini (Hymenoptera: Apoidea, Megachilidae), with emphasis on the genus Megachile*. Ph.D. dissertation, University of Kansas; Lawrence, Kansas; 274 pp.
- Gonzalez, V.H., T. Griswold, C.J. Praz, & B.N. Danforth. 2012. Phylogeny of the bee family Megachilidae (Hymenoptera: Apoidea) based on adult morphology. *Systematic Entomology* 37(2): 261–286.
- Gonzalez, V.H., M.S. Engel, M. Lucia, & L.J. Alvarez. 2013. Species status and new distribution records for *Lithurgus huberi* (Hymenoptera, Megachilidae, Lithurginae). *Journal of Hymenoptera Research* 30: 13–18.
- Griswold, T., & V.H. Gonzalez. 2011. New species of the Eastern Hemisphere genera *Afroheriades* and *Noteriades* (Hymenoptera, Megachilidae), with keys to species of the former. *ZooKeys* 159: 65–80.
- Kirby, W.F. 1900. Hymenoptera. In: Andrews, C.W. (Ed.), *A Monograph of Christmas Island (Indian Ocean): Physical features and geology by Charles W. Andrews, B.A., B.Sc., F.G.S., with Descriptions of the Fauna and Flora by Numerous Contributors*: 81–88. British Museum (Natural History); London, UK; xiii+[i]+337pp., +21 pls.
- Latreille, P.A. 1825. *Familles Naturelles du Règne Animal, exposées succinctement et dans un ordre analytique, avec l'indication de leurs genres*. J.-B. Baillière; Paris, France; [ii]+570 pp.
- Lieftinck, M.A. 1939. Uit het leven van *Lithurgus atratus*, een indisch houtbijtje. *Tropische Natuur* 28: 193–201.

- Michener, C.D. 1965. A classification of the bees of the Australian and South Pacific regions. *Bulletin of the American Museum of Natural History* 130: 1–362.
- Michener, C.D. 1983. The classification of the Lithurginae (Hymenoptera: Megachilidae). *Pan-Pacific Entomologist* 59(1–4): 176–187.
- Michener, C.D. 1997. Genus-group names of bees and supplemental family-group names. *Scientific Papers, Natural History Museum, University of Kansas* 1: 1–81.
- Michener, C.D. 2007. *The Bees of the World* [2nd Edition]. Johns Hopkins University Press; Baltimore, MD; xvi+[i]+953 pp., +20 pls.
- Moure, J.S. 1949. Las especies Chilenas de la sub-familia Lithurginae (Hym.-Apoidea). *Archivos do Museu Paranaense* 7(5): 265–286.
- Moure, J.S., & G.A.R. Melo. 2007. Lithurgini Newman, 1834. In: Moure, J.S., D. Urban, G.A.R. Melo (Eds.), *Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region*: 914–917. Sociedade Brasileira de Entomologia; Curitiba, Brazil; xiv+1058 pp. [updated at <http://www.moure.cria.org.br/catalogue> (last accessed 10 May 2013)].
- Newman, E. 1834. Attempted division of British insects into natural orders. *Entomological Magazine* 2: 379–431.
- Peters, D.S. 1970. Die Stellung von *Heriadopsis* Cockerell 1931 (Insecta: Hymenoptera: Apoidea: Megachilidae). *Senckenbergiana Biologica* 51(3–4): 199–203.
- Roig-Alsina, A. 2006. *Hylaeus punctatus* (Brullé) (Colletidae), a Palaearctic bee long established in South America. *Journal of Hymenoptera Research* 15(2): 286–289.
- Roig-Alsina, A., & C.D. Michener. 1993. Studies of the phylogeny and classification of long-tongued bees (Hymenoptera: Apoidea). *University of Kansas Science Bulletin* 55(4): 124–162.
- Smith, F. 1853. *Catalogue of Hymenopterous Insects in the Collection of the British Museum. Part I. Andrenidae and Apidae*. Taylor and Francis; London, UK; 197 pp., +6 pls.
- Smith, F. 1868. Descriptions of aculeate Hymenoptera from Australia. *Transactions of the Royal Entomological Society of London* 16(2): 231–258.
- Snelling, R.R. 1983. The North American species of the bee genus *Lithurge* (Hymenoptera: Megachilidae). *Contributions in Science* 343: 1–11.

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APPENDIX

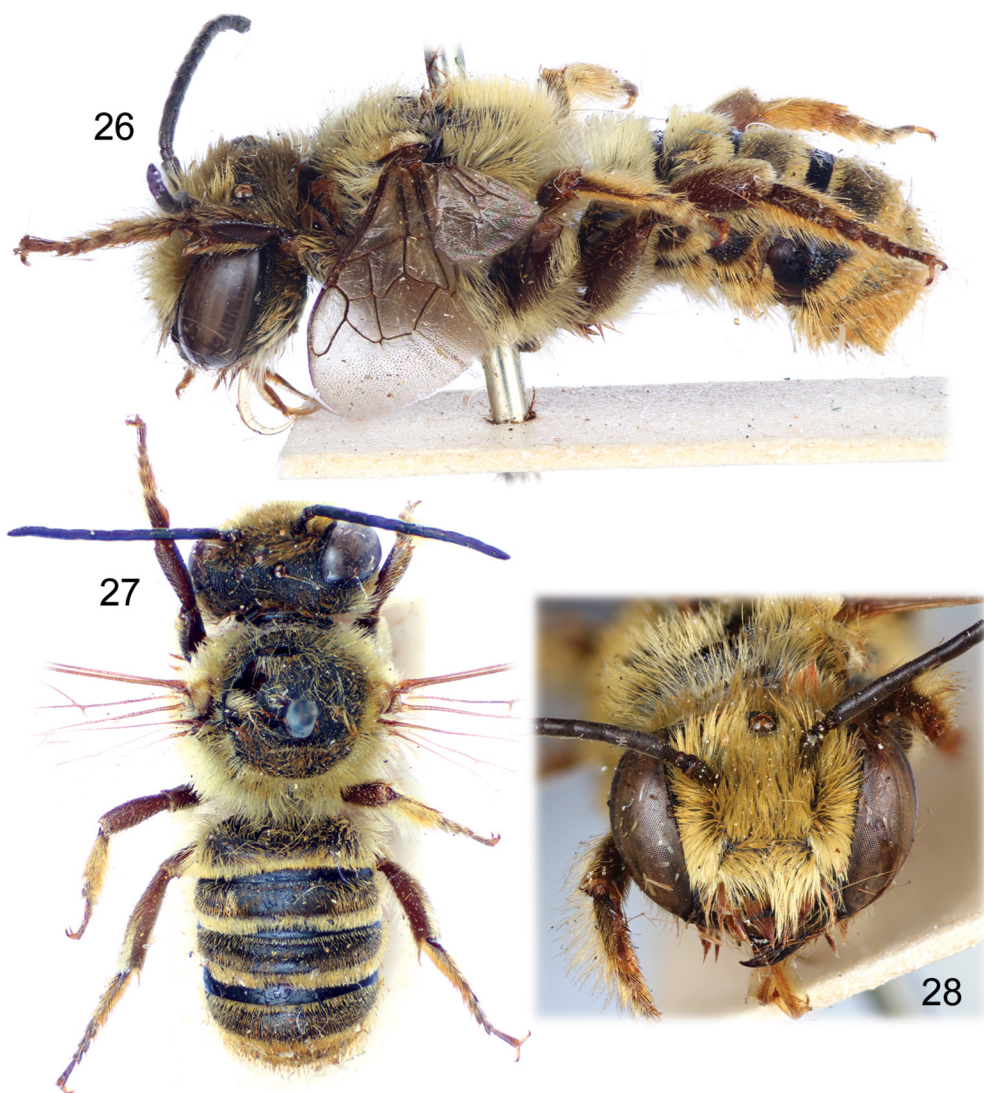
Taxonomic notes and lectotype designation for *Megachile rotundipennis* Kirby
(Megachilinae: Megachilini)

Megachile (Eutricharaea) rotundipennis Kirby
(Figs. 26–28)

Megachile rotundipennis Kirby in Andrews, 1900: 87. Lectotype (**new designation**): NHML Hym. 17.a.2068b; ♂, near Flying-Fish Cove, Christmas Island, Australia.

COMMENTS: Kirby (1900) described this species from five males and one female and did not designate a holotype. Thus, in order to stabilize the name, we designate one of the male syntypes as lectotype (Figs. 26–28). The label data for this specimen are as follow: West coast, Oct. 1897 // Christmas I., C.W. Andrews, 98–20. // *Megachile rotundipennis* Kb. Type ♂ [handwritten] // Type, B.M. Type Hym 17a.2068b. // Lectotype, *Megachile rotundipennis* Kirby des. V.H. Gonzalez, M.S. Engel & T. Griswold ♂. The single female of the syntype series was subsequently described as *L. andrewsi* by Cockerell (1909) (*vide supra*).

Megachile rotundipennis runs to the subgenus *Eutricharaea* Thomson in the key to the subgenera of *Megachile* of Michener (2007). This subgenus is the largest group of *Megachile* with many species greatly confused, particularly from Southeast Asia; most of them are known from the type series or from a reduced number of specimens, such as *M. rotundipennis*. Within *Eutricharaea*, *M. rotundipennis* is morphologically similar to *M. nivescens* Kirby, a species also currently known from Christmas Island.



Figures 26–28. Photomicrographs of lectotype male of *Megachile* (*Eutricharaea*) *rotundipennis* Kirby. 26. Lateral habitus. 27. Dorsal habitus. 28. Facial view.



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